VERIFICATION OF TRANSLATION

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declare as follows:

1. That I am well acquainted with both the English and Japanese languages, and

2. That the attached document is a true and correct translation made by me to the best of my knowledge and belief of;

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[TITLE OF THE INVENTION] Optical Laminated Body, Lighting Equipment and Area Luminescence Equipment

[SCOPE OF CLAIM FOR PATENT]

[Claim 1] An optical laminated body comprising:

a polarizing layer,

a first transparent film disposed closely to a front surface of the polarizing layer, and

a second transparent film disposed closely to a back surface of the polarizing layer,

characterized in that the polarizing layer comprises a reflective polarizing film, and both of the first transparent film and the second transparent film are diffusive films.

[Claim 2] A lighting equipment that illuminates an illuminating body, characterized in that the lighting equipment comprises:

(A) the optical laminated body of claim 1, and

(B) a surface light source supplying light to the optical laminated body, through a light-entrancing-surface (an opposite surface to a surface contacting closely to the polarizing layer) of the first transparent film of the optical laminated body,

the light illuminating the illuminating body is diffused-polarized light emitted from a light emitting surface (an opposite surface to a surface contacting closely to the polarizing layer) of the second transparent film of the laminated body.

[Claim 3] An area luminescence equipment comprising the lighting equipment of claim 2, and a transparent illuminating body illuminated thereby from back surface of the illuminating body,

characterized in that there is no diffusive plate disposed between the lighting equipment and the illuminating body.

[DETAILED DESCRIPTION OF THE INVENTION]

[Technical Field of the Invention]

The present invention relates to an improvement of an area luminescence equipment such as light display equipment and also relates to a lighting equipment such as back light equipment used for forming such an area luminescence equipment, and an optical laminated body used for forming such a lighting equipment. The optical laminated body of the present invention can be used as a so-called brightness-increasing film for improving the brightness of the area luminescence equipment in the area luminescence equipment such as liquid display equipment.

[Prior Art]

There has hitherto been known those using an optical film as a so-called brightness-increasing film for improving the brightness of an area luminescence equipment in the area luminescence equipment such as liquid display equipment. For example, it is an area luminescence equipment as shown in Fig. 1.

In the example shown in Fig. 1, light from a surface light source 91 is supplied to a lower diffusive plate 92 through an air layer 94-1, and light transmitted the lower diffusive plate 92 is diffused/emitted and then supplied to an optical film 93 through an air layer 94-2. Light supplied to the optical film 93 penetrates the optical film 93 and transmitted light is directly supplied to an upper diffusive plate 96 through an air layer 94-3, diffused/emitted and then supplied to an illuminating body 97 (liquid crystal display panel) through an air layer 94-4. The phrase "through the air layer" in this specification means that adjacent parts (e.g. surface light source and lower diffusive plate, etc.) are not closely contacted, optically.

An equipment with such a construction is disclosed, for example, in Japanese Unexamined Patent Publication (Kokai) No. 6-160639. In the equipment disclosed in this publication, a surface light source is a light guiding

plate (corresponding to the reference numeral 99 in Fig. 1) comprising a linear light source (corresponding to the reference numeral 98 in Fig. 1) and a transparent material coated partially with a light diffusive substance. The light emitting surface of the light guiding plate is provided with a prism lens type optical film (brightness-increasing film) having a lot of parallel prism lens with a linear top arris. In this equipment, a dissipation power-brightness conversion efficiency is effectively enhanced by the brightness-increasing effect of the above optical film. In such an equipment, a dot printing of a light diffusive substance is applied on the bottom surface of the light guiding plate (an opposite surface to a surface facing the optical film) so as to obtain uniform light emission. The above lower diffusive plate is disposed directly on the light guiding plate so as to cover this dot printing, thereby making it impossible to see from the light emitting surface of the equipment. In an equipment disclosed in Japanese Unexamined Patent Publication (Kokai) No. 5-257144, an upper diffusive plate is disposed between the optical film and illuminating body, in addition to the above lower diffusive plate. When the above illuminating body is a liquid crystal panel, the upper diffusive plate is required to prevent optical close contact between a lower polarizing plate of a display and the optical film.

These diffusive plates are usually made of a polymer substrate and formed by subjecting at least light emitting surface to an embossing or matting treatment. In a prism lens type film, close contact (optical close contact) between the diffusive plate and optical film had to be avoided to make the best use of the brightness-increasing effect by a prism action.

As the optical film as described above, those other than the prism lens film (lens film) are also known. For

example, International Patent Publication (Kohyo) No. 9-506984 discloses a reflection type polarizing film having a brightness-increasing effect. This film can be used in place of the lens film described above and has hitherto been used so as not to be closely contacted with the diffusive plate, like the lens film. It is also known to use the polarizing film and lens film in combination. In this case, for example, two lens films are disposed between the lower diffusive plate and polarizing film.

On the other hand, a polarizing plate, which can be used as constituent parts of the area luminescence equipment, is also known, although it has not a brightness-increasing effect like the above optical film. This polarizing plate is used as a polarizing plate to be disposed on/under a liquid crystal layer of a liquid crystal panel so as to sandwich it. Such a polarizing panel is usually formed by adsorbing iodine or a dye on a polymer substrate such as polyvinyl alcohol, polyvinyl acetal or the like, and monoaxially stretching the substrate in a fixed direction, thereby to fix polymer orientation. Incidentally, this polarizing plate exerts a light absorbing type polarizing action known conventionally and is different from the above reflection type polarizing film. The reflection type polarizing film will be described in detail below but is, for example, a multi-layer optical film comprising a lot of dielectric layers disclosed in International Patent Publication (Kohyo) No. 9-507308.

Since the above polarizing plate comprises the polymer substrate as described above, expansion/contraction by a change in temperature/humidity and deformation such as warpage occur easily. Therefore, there is also known an optical laminated body wherein a plastic substrate having high optical transparency is laminated on only one surface (an opposite surface to a liquid crystal layer) of a polarizing plate to prevent

deformation of the polarizing plate, thereby to integrate them. Such an optical laminated body is disclosed, for example, in Japanese Unexamined Patent Publication (Kokai) Nos. 8-54620 and 8-110521. The above plastic substrate may also be semitransparent and is usually integrated with the polarizing plate by using an adhesive.

[Problems to be Solved by the Invention]

By the way, the above-described parts such as optical film, diffusive plate and the like are essential in view of optical design of the area luminescence equipment. However, when the number of parts is large, an operation of incorporating parts becomes complicated. In the optical system composed of a combination of these parts, since the area of the optical surface increases (an interface between the surface of parts and an air layer), the optical loss by surface reflection on the optical surface increases and the light transmitting efficiency is lowered. Therefore, it was difficult to improve the brightness of the area luminescence equipment.

Accordingly, an object of the present invention is to provide an optical laminated body which can reduce the number of parts, thereby to simplify an operation of incorporating parts in the production of an optical laminated body, and which can reduce the number of optical surfaces of the optical system as possible, thereby to prevent optical loss by interfacial reflection and to enhance the brightness of an area luminescence equipment.

Another object of the present invention is to provide a lighting equipment using such an optical laminated body.

Still another object of the present invention is to provide an area luminescence equipment using such a lighting equipment.

[Means for Solving the Problems]

To solve the problems described above, according to a first aspect of the present invention, there is provided an optical laminated body comprising:

a polarizing layer,

a first transparent film disposed closely to a front surface of the polarizing layer, and

a second transparent film disposed closely to a back surface of the polarizing layer,
characterized in that the polarizing layer comprises a reflective polarizing film, and both of the first transparent film and the second transparent film are diffusive films.

According to a second aspect of the present invention, there is provided a lighting equipment that illuminates an illuminating body, which is characterized in that the lighting equipment comprises:

(A) the optical laminated body of claim 1, and

(B) a surface light source supplying light to the optical laminated body, through a light-entrancing-surface (an opposite surface to a surface contacting closely to the polarizing layer) of the first transparent film of the optical laminated body,

the light illuminating the illuminating body is diffused-polarized light emitted from a light emitting surface (an opposite surface to a surface contacting closely to the polarizing layer) of the second transparent film of the laminated body.

According to a third aspect of the present invention, there is provided an area luminescence equipment comprising the lighting equipment of claim 2, and a transparent illuminating body illuminated thereby from back surface of the illuminating body,

characterized in that there is no diffusive plate disposed between the lighting equipment and the illuminating body.

As is apparent from the following detailed description, the optical laminated body of the present invention is characterized by that a polarizing layer comprises a reflective polarizing film, and both of a first transparent film disposed closely to a front surface of the polarizing layer and a second transparent film disposed closely to a back surface of the polarizing layer are diffusive films. Since the optical laminated body comprises the diffusive films, an upper diffusive plate and/or a lower diffusive plate of the prior art are not required when it is incorporated into the area luminescence equipment. Accordingly, the number of parts can be reduced, thereby making it possible to simplify the parts incorporating operation. The area luminescence equipment of the present invention can eliminate the optical surface between the diffusive plate and optical film, unlike a conventional area luminescence equipment. Accordingly, the optical loss by the interfacial reflection can be prevented, thereby making it possible to facilitate an increase in brightness of the area luminescence equipment. By the effect of the diffusive film closely disposed to the polarizing layer, it is possible to improve the brightness without influencing on the visual property.

The optical laminated body of the present invention is particularly useful for formation of the lighting equipment having the construction described above. The lighting equipment of the present invention can provide the area luminescence equipment having the effect described above by using the lighting equipment in combination with the illuminating body.

[Embodiments for Carrying Out the Invention]

The present invention will be further described by way of its embodiments.

(Polarizing layer)

In the optical laminated body of the present

invention, as shown in Fig. 2, first and second transparent films 22,23 each made of a diffusive film, which are disposed to a front surface and a back surface so as to sandwich a polarizing layer 21, are formed in closely contact with the polarizing layer 21.

In the present invention, the polarizing layer comprises a reflection type polarizing film. The reflection type polarizing film is usually a polarizing film capable of transmitting only light in an oscillation direction in parallel to one intrafacial axis (transmission axis) and reflecting the other light. That is, it exerts a polarizing action by transmitting only a light component in the oscillation direction in parallel to the above transmission axis among light incident into the polarizing film. However, light which did not penetrate the polarizing film is not substantially absorbed by the polarizing film, unlike a conventional light absorbing type polarizing plate. Accordingly, it is possible to return light reflected once by the polarizing film toward the polarizing layer again by a reflection element contained in the surface light source after returning (reflecting) to the surface light source side. Among light returned to the polarizing layer, the polarizing layer transmits only the light component in the oscillation direction in parallel to the above transmission axis and reflects the rest. That is, in the polarizing layer including a reflection type polarizing film, the intensity of the transmitted-polarized light can be enhanced by repeating such a transmission-reflection action. Accordingly, the brightness of the illuminating body by the polarized-light can be effectively enhanced. At this time, if the illuminating body is a transparent body (e.g. liquid crystal panel, etc.), the brightness of the illuminating body is effectively enhanced.

The reflection type polarizing film is usually a

dielectric reflective film comprising a plurality of dielectric layers. As such a dielectric reflective film, for example, a multi-layer film disclosed in International Patent Publication (Kohyo) No. 9-507308 can be preferably used.

For example, a dielectric layer comprises a first group dielectric unit composed of a plurality of layers made of a first polymer and a second group dielectric unit composed of a plurality of layers made of a second polymer having a refractive index different from that of the first polymer in combination. In that case, the first and second group dielectric units are used in combination by alternatively laminating the layer made of the first polymer and the layer made of the second polymer and at least one of the first and second group dielectric units comprises a one-fourth wavelength layer wherein the product (n•d) of thickness (d, unit: nm) and refractive index (n) of the polymer is one-fourth of the wavelength of the reflected light. At this time, when any one of the first and second polymers has optical anisotropy in the light-receiving surface (for example, when any one layer is monoaxially stretched), such a dielectric reflective film serves as a reflective film having a polarizing action. Usually, the reflected light is also visible light.

In the dielectric reflective film as described above, the reflectance of the above reflected light is usually not less than 70%, preferably not less than 80%, and particularly preferably not less than 90%. The transmittance of the transmitted light is usually not less than 60%, preferably not less than 70%, and particularly preferably not less than 80%. The terms "reflectance" and "transmittance" in the present specification are values measured by using a spectrophotometer.

The reflection type polarizing film is usually made by alternatively laminating (ABAB ...) two different kinds of polymers (A and B). At this time, in a multi-layer film (ABAB ...) comprising two kinds of these polymers, one polymer is stretched (e.g. stretching ratio: about 5:1) along one axis (X-axis) but is not substantially stretched (1:1) along the other axis (Y-axis intersected perpendicularly to X-axis). Hereinafter, this X-axis is referred to as a "stretching direction" and the Y-axis is referred to as a "lateral direction".

As one polymer (B), those having an apparent refractive index whose value is not substantially changed by the stretching process (optically anisotropic) are usually used. As the other polymer (A), those having a refractive index whose value is changed by the stretching process are used. For example, a monoaxially-stretched sheet of the polymer (A) has a first refractive index larger than the apparent refractive index of the polymer (B) in the stretching direction, and has a second refractive index which is almost the same as the apparent refractive index of the polymer (B) in the lateral direction.

In the multi-layer film (ABAB ...) of the polymer, the refractive index of the intrafacial axis (axis parallel to the surface of the film) is defined as an effective refractive index to the surface-polarized incident light, and this polarized surface is parallel to the above intrafacial surface. Accordingly, after stretching, the multi-layer film (ABAB ...) has a large difference in interlayer refractive index, but the interlayer refractive indexes are substantially the same in the lateral direction. Whereby this multi-layer film serves as a reflection type (reflection type) polarizing film which propagates a polarizing component of the incident light. The above Y-axis is defined as a

propagation (transmission) axis and light penetrating the reflection type polarizing film has a first oscillation direction.

On the other hand, light which does not penetrate the reflection type polarizing film is polarizing film having a second oscillation direction intersected perpendicular (at right angles) to the first oscillation direction. The polarized light having the second oscillation direction is incident upon the surface of the film along the above X-axis and is reflected by an action of the above difference in interlayer refractive index. Accordingly, the above X-axis is defined as a reflection axis. In such an aspect, the reflection type polarizing film transmits only light having a selected oscillation direction (or polarizing direction).

The number of the polymer layers in the above polarizing film may be selected as small as possible so as to obtain desired optical characteristics. In the polarizing film, the number of the layers is less than 10,000, preferably less than 5,000, and more preferably less than 3,000. In addition, the thickness of the polarizing film is usually from 15 to 1,000 μm.

The above polymer is not specifically limited as far as it is transparent. The polymer includes, for example, polycarbonate, acrylic resin, polyester, epoxy resin, polyurethane, polyamide, polyolefin, silicone (including modified silicone such as silicone polyurea, etc.) or the like.

The polarizing film usually has a smooth surface, but can be provided with an irregular surface as far as the effect of the present invention is not adversely affected. In this case, the convex portion can be formed by a matting or embossing treatment so as to afford the same effect as that of the diffusive film. In this case, the outer-most layer of the polarizing film can also be

regarded as the diffusive film by eliminating the diffusive film disposed closely to this surface, separately.

The number of the polarizing film included in the polarizing layer is usually one, but a plurality of films can also be included. Furthermore, a film or layer other than the polarizing film may also be included as far as the effect of the present invention is not adversely affected. The film or layer includes, for example, surface protective layer, antistatic layer, transparent supporting layer (for the purpose of enhancing its strength), magnetic shield layer, adhesive layer, primer layer or the like. Incidentally, the thickness of the whole polarizing layer should be selected so that the resulting optical laminated body does not become bulky, and is usually from 5 to 2,000 μm.

(First and second light transparent film)

The light transparent film used in the present invention is a diffusive film having a diffuse transmission property. Such a diffusive film is usually a film wherein the surface of the polymer film is subjected to a diffusion surface treatment by matting or embossing. It can also be formed by subjecting the surface to the other diffusion surface treatment such as sandblasting or arrangement of a plurality of micro-projections. Furthermore, diffusive particles can also be contained by diffusing therein as far as the effect of the present invention is not adversely affected.

The thickness of the whole diffusive film should be selected so that the resulting laminated body does not become bulky, and is usually from 5 to 2,000 μm. Incidentally, the first and second transparent films (i.e. first and second diffusive films) may be the same or different. For example, a diffusive film wherein at least one surface (principal surface) is subjected to a

diffusion surface treatment is used as the first and second diffusive films and, furthermore, one diffusive film is closely disposed to the surface of the polarizing layer so that a light-entrancing-surface (an opposite surface to a surface contacting closely to the polarizing layer) of the first transparent film becomes a diffused surface, while the other diffusive film is closely disposed to the back surface of the polarizing layer so that a light emitting surface (an opposite surface to a surface contacting closely to the polarizing layer) of the second transparent film becomes a diffused surface.

The diffusive surface can be formed, for example, by using a resin composition comprising a resin such as polycarbonate resin, acrylic resin, polyester resin, epoxy resin, polyurethane resin, polyamide resin, polyolefin resin, silicone resin (including modified silicone such as silicone polyurea) or the like.

The diffusive film is preferably a film subjected to a diffusion surface treatment. In this case, transmission loss by absorption in the diffusive film can be effectively prevented and it becomes easier to enhance the illuminance or brightness of the illuminating body. From such a point of view, the transmittance of the film before subjecting to the diffusion surface treatment (i.e. material itself of the diffusive film) is usually not less than 85%, preferably not less than 90%, and particularly preferably not less than 95%.

On the other hand, the diffusion performance of the diffusive film is not specifically limited as far as the effect of the present invention is not adversely affected. For example, the haze of the diffusive film is usually from 40 to 90%, preferably from 45 to 87%, and particularly preferably from 50 to 85%. The "haze" in the present invention is a value measured by using a haze mater in accordance with JIS K7105 6.4. The roughness (Ra: centerline average roughness) of the diffused

surface is usually less than 30 μm, and preferably not more than 20 μm.

As far as the effect of the present invention is not adversely affected, the transparent film may be colored. Furthermore, as far as the effect of the present invention is not adversely affected, the transparent film may include a film or layer other than the diffusive film, and may have a diffusion property entirely. The film or layer includes, for example, surface protective layer, antistatic layer, transparent supporting layer (for the purpose of enhancing its strength), magnetic shield layer, adhesive layer, primer layer or the like.

(Optical laminated body)

As is shown in Fig. 2, as means 24,25 for disposing first and second diffusive films 22,23 closely to a polarizing film 21, a close contact layer containing an adhesive.

As the adhesive, for example, a conventional one such as pressure-sensitive adhesive, heat-sensitive adhesive (including hot melt), solvent-volatile adhesive or the like can be used. A curing type adhesive is preferred. It becomes easy to provide an optical laminated body having high heat stability (heat shrinkage and heat deformation occur hardly) by disposing two transparent films closely to the surface and back surface of the polarizing layer and curing the adhesive. Since the multi-layer film (polarizing film) as described above has physical properties such as linear expansion coefficient, and anisotropy, surface waviness is liable to be caused by an external heat effect such as heat shock. Accordingly, in the optical laminated body comprising a polarizing film made of a multi-layer film, an aspect using a curing type adhesive as a means for disposing a transparent film closely to a polarizing

layer is one of particularly preferred embodiments.

In the curing of the adhesive, a conventional means such as heat, moisture, electron beam, ultraviolet light, or the like can be employed. However, an ultraviolet-curing type adhesive is preferred. In the heat curing and electron beam curing, there is a fear that a comparatively large amount of heat is generated and the polarizing film and/or diffusive film are thermally damaged (deformation). On the other hand, in the case of moisture curing and room temperature curing, there is a fear that it becomes difficult to enhance the productivity of the optical laminated body because the curing time is comparatively long. In the case of the ultraviolet-curing type adhesive, the curing time is comparatively short and the calorie generated on a curing treatment is comparatively small.

The material of the adhesive is not specifically limited as far as the effect of the present invention is not adversely affected. For example, there can be used a composition comprising a resin such as acrylic resin, polyester resin, epoxy resin, polyurethane resin, polyolefin resin, silicone resin, silicone polyurea or the like. In the case of the curing type one, the above resin composition can contain a curing (reactive) monomer and/or oligomer.

The adhesive is usually disposed on the close contact surface (adhesive surface) of the polarizing layer or transparent film in the form of a close contact layer (i.e. adhesive layer). The thickness of the close contact layer is usually from 5 to 200 μm. The transmittance of the adhesive is not specifically limited, but is usually not less than 60%, preferably not less than 70%, and particularly preferably not less than 80%.

As the material of the above close contact layer,

those other than the adhesive can be used. For example, it is possible to dispose closely, optically, by using a close contact layer containing a rubber or elastomer (whose adhesive strength is smaller than that of a general adhesive) so that an optical interface is not formed between the transparent film and polarizing layer. As far as the brightness-increasing effect is not adversely affected, the close contact layer can not be disposed so as to contact the transparent film closely to the polarizing layer. For example, the transparent film and polarizing film may also be closely contacted so that an air layer is not present substantially by smoothening the close contact surface between them.

The optically laminated body is usually disposed so as not to contact optically with the light source. For example, when the light source is a surface light source (details will be described hereinafter), the optically laminated body is merely laminated on the light emitting surface of the surface light source or laminated thereon through a spacer (e.g. bar or wire having a surface area smaller than the area of the light emitting surface). As far as the brightness-increasing effect is not adversely affected, it can also be disposed through the diffusive film. However, in order to effectively reduce the number of parts to be incorporated, it is preferably laminated merely on the light emitting surface of the light source through no spacer or diffusive film. Accordingly, the diffusive film in contact with the light source of the optical laminated body is preferably formed by subjecting to a diffusion surface treatment such as embossing, matting or the like.

(Lightening equipment)

The lightening equipment according to the present invention comprises (A) the optical laminated body, and (B) the surface light source supplying light to the optical laminated body, through a light-entrancing-

surface (an opposite surface to a surface contacting closely to the polarizing layer) of the first transparent film, the light illuminating the illuminating body is diffused-polarized light which is usually supplied from the above surface light source and emitted from a light emitting surface (an opposite surface to a surface contacting closely to the polarizing layer) of the second transparent film through the optical laminated body.

The illuminating body is, for example, a display body including a liquid crystal panel and constitutes a monitor of PC (personal computer) or a television set, or an adjustable display type billboard or signboard. When the liquid crystal panel is a transparent type one and the illuminating body is transparent, the illuminating body is illuminated by a lightening equipment from the back surface of the illuminating body and it can be visually recognized from the front surface of the illuminating body. In such an aspect, the illuminating body is a liquid crystal display body and the above lightening equipment is usually referred to as a back light equipment. In addition, an area luminescence equipment formed by using such a back light equipment in combination with the liquid crystal display body is usually a monitor of a personal computer, which is also referred to as a liquid crystal display equipment. Such a liquid crystal display equipment (area luminescence equipment) can effectively enhance the brightness of the liquid crystal image surface by the action of the above optical laminated body and, at the same time, it can reduce the number of parts of the equipment, thereby making it possible to simplify an operation of incorporating parts in the production of the area luminescence equipment.

A lightening equipment 100 of the present invention can be formed by disposing the above optical laminated body 2 on one principal surface (light emitting surface)

11 of a light guiding plate 1 as shown in Fig. 3. On at least one end 12 (end in a direction crossing the above principal surface) of the light guiding plate 1, a linear light source 3 is disposed. On the other principal surface 13 of the light guiding plate 1, a plurality of diffusing points (not shown) by dot printing of a light diffusive substance is usually formed. Furthermore, a reflective member (not shown) is disposed to substantially cover the whole other principal surface 13. This reflective member is, for example, a white opaque diffuse reflective sheet or a mirror finished reflective sheet. The mirror finished reflective sheet includes those wherein a metal layer is disposed on the surface of a polymer film and a dielectric reflective film containing no metal layer. The dielectric used in the dielectric reflective film is usually a polymer. With such a construction, substantially whole light introduced into the light guiding plate 1 from the light source 3 can be converted into diffused light emitted uniformly from a light emitting surface 11 of the light guiding plate 1, thereby making it possible to effectively enhance the illuminance of the lightening equipment. Incidentally, in this example, the portion composed of a combination of the above reflective member and light source 3 becomes a surface light source 10.

It is preferred that the optical laminated body 2 is disposed on the light emitting surface (light emitting surface 11 of the light guiding plate) of the above surface light source 10 through an air layer 51. That is, these members are not closely contacted each other, optically, but are merely laminated or laminated through a spacer. Whereby light is supplied to the optical laminated body 2 from the surface light source 10 through the air layer 51, thereby making it possible to effectively reduce light transmission loss due to light reflection in the optical interface formed by parts

disposed between the surface light source and optical laminated body.

Light illuminating an illuminating body 4 is emitted from a light emitting surface 20 (light emitting surface of a second transparent film) of the optical laminated body 2, but is converted into diffused-polarized light by penetrating the polarizing layer of the optical laminated body 2 and penetrating two diffusive films.

As the light guiding plate and light source used in the above example, conventionally used one can be used. For example, when the lightening equipment is used as a back-lightening equipment for liquid crystal panel, a transparent plate made of quartz, glass, resin (acrylic resin) or the like can be used as the light guiding plate, and a linear light source such as fluorescent tube, hot cathode, cold cathode, neon tubing or the like can be used as the light source. A combination of a side light extraction type light fiber and a light source for supplying light to the light fiber from the end portion of the light fiber can be used as the linear light source.

The thickness of the whole light guiding plate is usually from 0.1 to 30 mm, and preferably from 0.3 to 20 mm. In addition, the power of the light source is usually from 0.5 to 200 W, and preferably from 1 to 150 W. The shape of the light source is not specifically limited, and it is preferred that a reflective film and a reflector are usually disposed around the light emitting surface of the light source, thereby introducing substantially whole light from the light source into the light conductive plate.

The number of the light source included in the above surface light source is not limited to one, and may also be plural. For example, each one light source can also be disposed to both ends facing each other of the

above light guiding plate. Using a light guiding member having a light guiding space in place of the light guiding plate, one or more light sources can also be disposed in the light guiding space. Furthermore, a sheet-like electroluminescence (EL) element can also be used as the surface light source.

A prism lens type brightness-increasing film (lens film) can also be disposed between the surface light source and optical laminated body as usual. For example, one or more lens films are disposed between the illuminating body and optical laminated body. Whereby an increase in brightness of the area luminescence equipment is further facilitated. Incidentally, when two lens films are disposed in such a manner that the longitudinal directions of respective prism lens are intersected perpendicularly each other.

When using the optical laminated body of the present invention in combination with the lens film, it can be considered that one lens film is added in place of elimination of two diffusive plates. In this case, the brightness can be effectively reduced without increasing the number of parts. However, one lens film is preferably used to reduce the number of parts as possible. When using the optical laminated body of the present invention, one lens film and diffusive plate can be reduced in comparison with a conventional area luminescence equipment requiring two lens films, thereby making it possible to increase the brightness in comparison with a conventional one.

Incidentally, the prism surface of the lens film is disposed so as to face the optical laminated body so that the lens film and optical laminated body are not closely contacted, optically. Whereby the visual angle of the light emitting surface of the area luminescence equipment is reduced as small as possible and an increase in brightness is further enhanced. Specific examples of the

lens film, which can be used in the present invention, include a brightness-increasing film; BEF™ series manufactured by 3M Co.

(Area luminescence equipment)

The area luminescence equipment of the present invention comprises the above lighting equipment and a transparent illuminating body illuminated thereby from back surface of the illuminating body, and an upper diffusive plate (corresponding to the reference numeral 96 in Fig. 1) as usual is not disposed between the illuminating body and lighting equipment. In the area luminescence equipment of the present invention, light from the above surface light source can be converted into diffused-polarized light whose illuminance is effectively enhanced only by using the optical laminated body as the lightening equipment (without using the diffusive plate as described above). Since light from the lightening equipment can eliminate transmission loss due to the optical interfacial reflection formed by the diffusive plate, the brightness of the area luminescence equipment can be effectively enhanced. In addition, the effect of preventing visual recognition (visual recognition through the illuminating body) of a diffusing point included in the light guiding plate can be obtained by the effect of the first and second diffusive films included in the optical laminated body. Accordingly, it is substantially the same as that in the production of a conventional area luminescence equipment, except that an operation of incorporating the diffusive plate is eliminated. Since users of the optical laminated body used for producing the area luminescence equipment can purchase an optical laminated body as one parts from a supplier and treat it, it is possible to simplify user's parts incorporating operation.

In the area luminescence equipment 111 of the present invention, as shown in Fig. 3, a transparent

illuminating body 4, e.g. liquid panel is preferably disposed on an optical laminated body 2 of a lightening equipment 100 through an air layer 52. That is, these equipments are not closely contacted, optically, but are merely laminated or laminated through a spacer. Whereby transmittance loss can be effectively reduced by supplying light to the illuminating body 4 from the lightening equipment 100 through the air layer.

The area luminescence equipment is completed by laminating the respective parts (e.g. illuminating body 4, optical laminated body 2, surface light source 10, optionally included lens film, etc.) so as not to contact closely, optically, and integrally fixing the respective parts with a flame capable of receiving the periphery of the end portion of the respective parts.

Describing the construction of the area luminescence equipment of the present invention from the other point of view, it is possible to consider that the area luminescence equipment of the present invention is the same as that such as conventional liquid display equipment (this respect becomes more apparent with reference to Fig. 1 and Fig. 3), except that:
(a) the above optically laminated body is used as a brightness-increasing film, and
(b) the upper diffusive plate between the optical laminated body and illuminating body is eliminated (preferably, the lower diffusive plate between the optical laminated body and surface light source is also eliminated). Accordingly, all and the parts of the area luminescence equipment of the present invention can be properly designed in the same manner as in case of a conventional area luminescence equipment.

The transparent illuminating body is usually a liquid crystal panel (LCD). Such LCD is illuminated from the back surface opposite to a surface (light emitting surface) on which a liquid crystal image is visually

recognized. Almost all light, which penetrates LCD thereby to make it possible to visually recognize the liquid crystal image, is light polarized by the polarizing plate included in LCD. Accordingly, it is one of most effective means to effectively enhance the intensity of the LCD-transmitting polarizing component out of light illuminated from the lightening equipment, as a means for enhancing the intensity (illuminance) of light supplied from the lightening equipment, thereby to enhance the brightness of the area luminescence equipment. Furthermore, it is one of most effective means to use diffused-polarized light as the illuminated light of the lightening equipment, as a means for enhancing the uniformity of the brightness of the light emitting surface.

[Examples]

The present invention will be described with reference to the following examples and comparative examples.

Example 1

An optical laminated body of the example of the present invention was made in the following manner. As a polarizing layer, a reflection type polarizing film (thickness: 130 μm) was used. As first and second transparent films, an embossed type diffusive film "Yupiron™ FEM M01" (thickness: 130 μm, haze: 79%) manufactured by Mitsubishi Engineering Plastic Co. was used.

The above polarizing film was a multi-layer type dielectric reflection film made by the method described above. A first polymer layer of a first dielectric unit contained in this polarizing film was monoaxially stretched, while a second polymer layer of a second dielectric unit was not stretched. In the case of the above first polymer layer, the direction intersected

perpendicularly to a stretching direction is a transmission axis and the above stretching direction is a reflection axis.

A transmittance to light having a wavelength of 550 nm in the transmission axis of this polarizing film was 85% and an average transmittance in the region ranging from 400 to 800 nm was about 85%. The transmittance to light having a wavelength of 550 nm in the reflection axis of this polarizing film was 95% and the average transmittance in the region ranging from 400 to 800 nm was about 95%.

The above diffusive film was disposed closely to the front and back surfaces of the above polarizing film by using an ultraviolet-curing type adhesive. Incidentally, this ultraviolet-curing type adhesive contains an alkyl acrylate monomer and oligomer as a main component. After the above three films were laminated each other, the adhesive was cured. Whereby an optical laminated body having a thickness of about 430 μm could be made. In the polarizing film and diffusive film, a thermal damage after a curing treatment did not occur and deformation such as surface waviness was not observed.

Subsequently, a lighting equipment of the example of the present invention was made in the following manner. As a surface light source, 11.3 type edge-lighting back-light manufactured by Hitachi Corp. was used. This back-light comprises a light guiding plate made of an acrylic resin and is characterized by that light is introduced into the light guiding plate from a fluorescent tube disposed at the end portion. In addition, a plurality of micro-diffusing points is disposed on the opposite surface to a light emitting surface and this surface was covered with a reflection plate.

The optical laminated body obtained as described

above was cut into a piece having the same planar size as that of the light emitting surface of this surface light source, which was laminated on this light emitting surface, thereby to complete a lightening equipment of the present invention. Incidentally, the light emitting surface of the surface light source and diffusive film surface (a light-entrancing-surface subjected to a diffusion treatment of the first transparent film) of the optical laminated body were not closely contacted, optionally, and a thin air layer was present.

Finally, a transparent liquid crystal panel (LCD) was laminated on the diffusive film surface (a light-entrancing-surface subjected to a diffusion treatment of the second transparent film) of the optical laminated body of the lightening equipment obtained as described above, thereby to make an area luminescence equipment of the example of the present invention. This LCD was a 11.3 type TFT LCD (whose color is normally white) manufactured by Hitachi Corp. Incidentally, the lightening equipment and LCD were disposed so that a light transmission axis (a light transmission axis of a polarizing plate with a built-in CD) of LCD is parallel to that of a polarizing film of the optical laminated body. In addition, the light-entrancing-surface of LCD and diffusive film surface (a light emitting surface subjected to a diffusion treatment of the second transparent film) of the lightening equipment were not closely contacted, optionally, and a thin air layer was present.

Using the area luminescence equipment of this example, the brightness of the liquid crystal light emitting surface was measured. As a brightness measuring device, a brightness meter "EZ contrast 160D" manufactured by Eldim Co. was used. The brightness in the vicinity of the center of the light emitting surface of the area luminescence equipment of this example was

332 cd/cm^2.

Comparative Example 1

For comparison, an area luminescence equipment was made in the same manner as in Example 1, except that the above reflection type polarizing film was used in place of the optical laminated body and two diffusive plates (an upper position between the LCD and polarizing film and a lower position between the surface light source and polarizing film) was disposed without being disposed closely to the polarizing film. The brightness in the vicinity of the center of the light emitting surface of this area luminescence equipment of this example was 309 cd/cm^2. As the diffusive plate, the diffusive plate used in Example 1 was used as a lower diffusive plate and a diffusive plate PCPT (haze: about 56%) manufactured by Tsujimoto Denki Co. was used as an upper diffusive plate.

Comparative Test 1

The area luminescence equipments of Example 1 and Comparative Example 1 were compared. As a result, a diffusing point of the light guiding plate was not recognized from the liquid crystal surface of both of area luminescence equipments. Furthermore, the visual properties of the area luminescence equipments of Example 1 and Comparative Example 1 were almost the same. The measurement results of the visual properties are shown in Table 1 below. With respect to the visual properties, an angle, whose brightness is reduced to half of an axial brightness (visual angle: 0) in the direction in parallel to the transmission axis of the polarizing plate (ahorizontal direction) and the direction perpendicular to the direction (perpendicular direction) in the liquid crystal light emitting surface, was used as a visual angle.

As is apparent from the above description, according to the area luminescence equipment comprising the optical laminated body of the present invention, the

brightness is effectively increased without deteriorating the other characteristics such as visual property in comparison with those comprising a combination of a reflection type polarizing film and two diffusive plates disposed without being contacted closely with the reflection type polarizing film.

Example 2

An area luminescence equipment of this example was made in the same manner as in Example 1, except that one diffusive plate (the same diffusive plate as that used in Example 1), which is not contacted closely with the surface light source and optical laminated body, was used. The brightness measured in the same manner as in Example 1 was 336 cd/cm^2. Incidentally, a diffusing point of the light guiding plate was not visually recognized from the liquid crystal surface of the area luminescence equipment of this example. In addition, the measurement results of the visual property of the area luminescence equipment of this example are shown in Table 1 below.

Table 1

Visual angle [unit: degree] in the case of using no lens film

	Example 1 No diffusive plate	Example 2 Lower diffusive film	Comparative Example 1 Upper/lower diffusive films
Horizontal direction	59	53	58
Perpendicular direction	49	49	51

Example 3

An area luminescence equipment of this example was made in the same manner as in Example 1, except that one lens film having a plurality of parallel linear prism lens was disposed between the optical laminated body and surface light source. The brightness measured in the

same manner as in Example 1 was 455 cd/cm².

In this example, the lens film was disposed so that the prism surface is contacted with the optical laminated body and that the lens film is not closely contacted, optically, with the light guiding plate of the surface light plate and optical laminated body. Incidentally, the above lens film was a brightness-increasing film "BEF II 90/50" manufactured by 3M Co. In addition, this lens film was disposed so that the longitudinal direction of the prism is intersected perpendicularly to that of a fluorescent tube of a back-light.

Comparative Example 2

For comparison, an area luminescence equipment of this example was made in the same manner as in Example 1, except that the above reflection type polarizing film was used in place of the optical laminated body and that two diffusive plates were disposed, that is, one diffusive plate was disposed between the polarizing film and light guiding plate and one diffusive plate was disposed between the lens film and liquid crystal panel. The brightness in the vicinity of the center of the light emitting surface of this area luminescence equipment was 382 cd/cm².

Comparative Test 2

The area luminescence equipments of Example 3 and Comparative Example 2 were compared. As a result, a diffusing point of the light guiding plate was not recognized from the liquid crystal surface of both of area luminescence equipments. Furthermore, the visual properties of the area luminescence equipments of Example 3 and Comparative Example 2 were almost the same. The measurement results of the visual properties are shown in Table 2 below.

As is apparent from the above description, according to the area luminescence equipment comprising the optical laminated body of the present invention, the

brightness is effectively increased without deteriorating the other characteristics such as visual property in comparison with those comprising a combination of a reflection type polarizing film and two diffusive plates disposed without being contacted closely with the reflection type polarizing film.

Comparative Example 3

An area luminescence equipment of this example was made in the same manner as in Comparative Example 2, except that the upper diffusive plate was not used. The brightness measured in the same manner as in Example 1 was 428 cd/cm^2. In addition, the measurement results of the visual property of the area luminescence equipment of this example are shown in Table 2 below.

In the area luminescence equipment of this example, the brightness was improved in comparison with Comparative Example 2 because the upper diffusive plate was not used, but an improvement in brightness was insufficient in comparison with Example 3.

Table 2

Visual angle [unit: degree] in the case of using one lens film

	Example 3 No diffusive plate	Comparative Example 2 Upper/lower diffusive films	Comparative Example 3 Lower diffusive film
Horizontal direction	48	49	50
Perpendicular direction	37	35	35

Example 4

An area luminescence equipment of this example was made in the same manner as in Example 1, except that two lens films having a plurality of parallel linear prism lens was disposed between the optical laminated body and surface light source. The brightness measured in the same manner as in Example 1 was 556 cd/cm^2.

In this example, two lens films were disposed so that the prism surface faces the optical laminated body side and that the lens film is not closely contacted, optically, with the light guiding plate of the surface light plate and optical laminated body. In addition, two lens films were not closely contacted, optically.

The longitudinal directions of the prism of two lens films are intersected perpendicularly each other and the longitudinal direction of the prism of the lens film at the side closed to the optical laminated body was intersected perpendicularly to the back-light. Incidentally, two above lens films were the same as that used in Example 3.

Comparative Example 4

For comparison, an area luminescence equipment of this example was made in the same manner as in Example 4 (two prisms), except that the above reflection type polarizing film was used in place of the optical laminated body and that two diffusive plates were disposed, that is, one diffusive plate was disposed between the polarizing film and light guiding plate and one diffusive plate was disposed between the lens film and liquid crystal panel. The brightness in the vicinity of the center of the light emitting surface of this area luminescence equipment was 411 cd/cm^2.

Comparative Test 3

The area luminescence equipments of Example 4 and Comparative Example 4 were compared. As a result, a diffusing point of the light guiding plate was not recognized from the liquid crystal surface of both of area luminescence equipments. Furthermore, the visual properties of the area luminescence equipments of Example 4 and Comparative Example 4 were almost the same. The measurement results of the visual properties are shown in Table 3 below.

As is apparent from the above description,

according to the area luminescence equipment comprising the optical laminated body of the present invention, the brightness is effectively increased without deteriorating the other characteristics such as visual property in comparison with those comprising a combination of a reflection type polarizing film and two diffusive plates disposed without being contacted closely with the reflection type polarizing film.

Example 5

An area luminescence equipment of the example of the present invention was made in the same manner as in Example 4, except that one diffusive plate (the same diffusive plate as that used in Example 1), which is not closely contacted with the surface light source and optical laminated body, was disposed between the surface light source and optical laminated body (lower position). The brightness measured in the same manner as in Example 4 was 433 cd/cm^2. Incidentally, a diffusing point of the light guiding plate could not be visually recognized from the liquid crystal surface of the area luminescence equipment of this example. The measurement results of the visual property of the area luminescence equipment of this example are shown in Table 3 below.

Table 3

Visual angle [unit: degree] in the case of using two lens film

	Example 4 No diffusive plate	Example 5 Lower diffusive film	Comparative Example 4 Upper/lower diffusive films
Horizontal direction	30	30	31
Perpendicular direction	28	28	28

Comparative Example 5

An area luminescence equipment of this example was made in the same manner as in Comparative Example 4,

except that the upper diffusive plate was not used. The brightness measured in the same manner as in Example 1 was 469 cd/cm^2. In the area luminescence equipment of this example, the brightness was improved in comparison with Comparative Example 4 because the upper diffusive plate was not used, but an improvement in brightness was insufficient in comparison with Example 4.

[Effect of the Invention]

As described above, the optical laminated body of the present invention is useful as an optical film (or parts), which is used to effectively (with effectively reduce transmission loss) converting illuminating light from the lightening equipment into diffused-polarized light and to effectively enhance the intensity (illuminance as the lightening equipment). In the area luminescence equipment comprising the lightening equipment of the present invention and a transparent illuminating body including LCD, the intensity of the polarizing component penetrating LCD is effectively enhanced and the uniformity of the brightness of the light emitting surface can also be enhanced. It is possible to reduce the number of constituent parts of the area luminescence equipment, thereby making it possible to simplify an operation of incorporating parts.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Fig. 1 is a cross-sectional view schematically showing a conventional area luminescence equipment.

[Fig. 2]

Fig. 2 is a cross-sectional view schematically showing one embodiment of an optical laminated body according to the present invention.

[Fig. 3]

Fig. 3 is a cross-sectional view schematically showing one embodiment of an area luminescence equipment according to the present invention.

[DESCRIPTION OF REFERENCE NUMERALS]

1 ... light guiding plate

2 ... optical laminated body

3 ... light source

4 ... illuminating body

10 ... surface light source

21 ... polarizing layer

22,23 ... light diffusive films

24,25 ... close contact layers

100 ... lighting equipment

111 ... area luminescence equipment

図 1
Fig 1

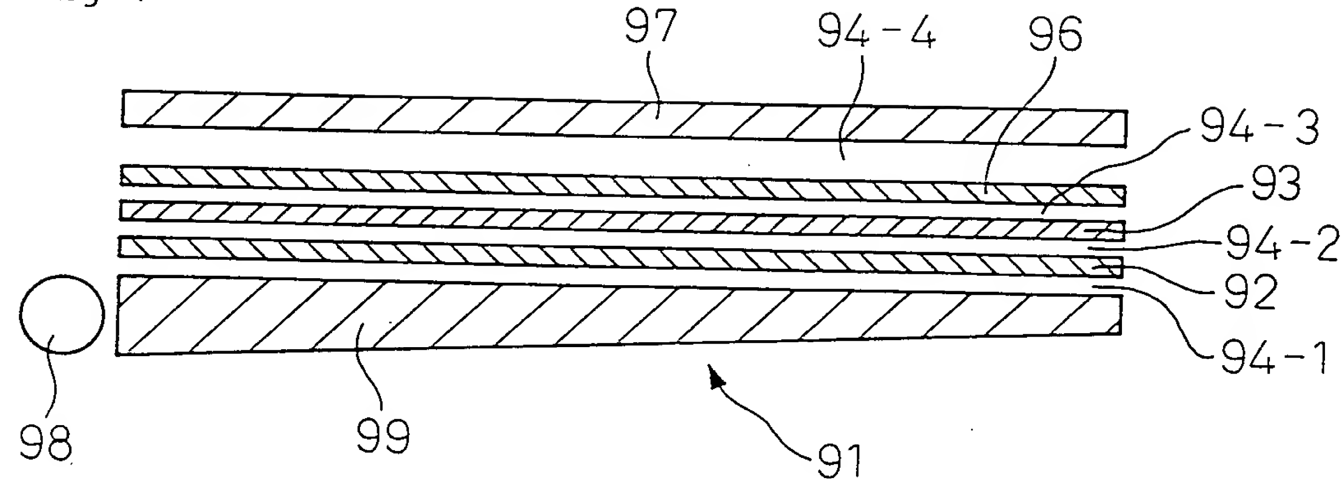


図 2
Fig 2

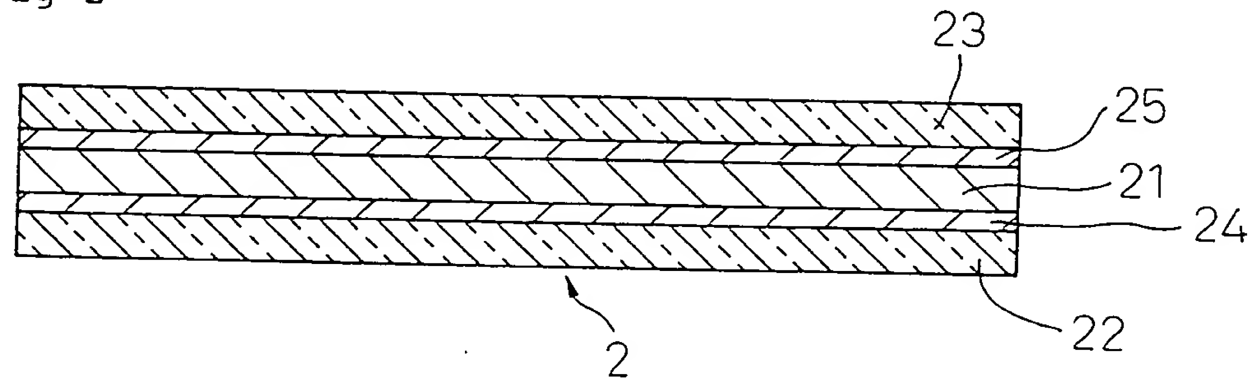
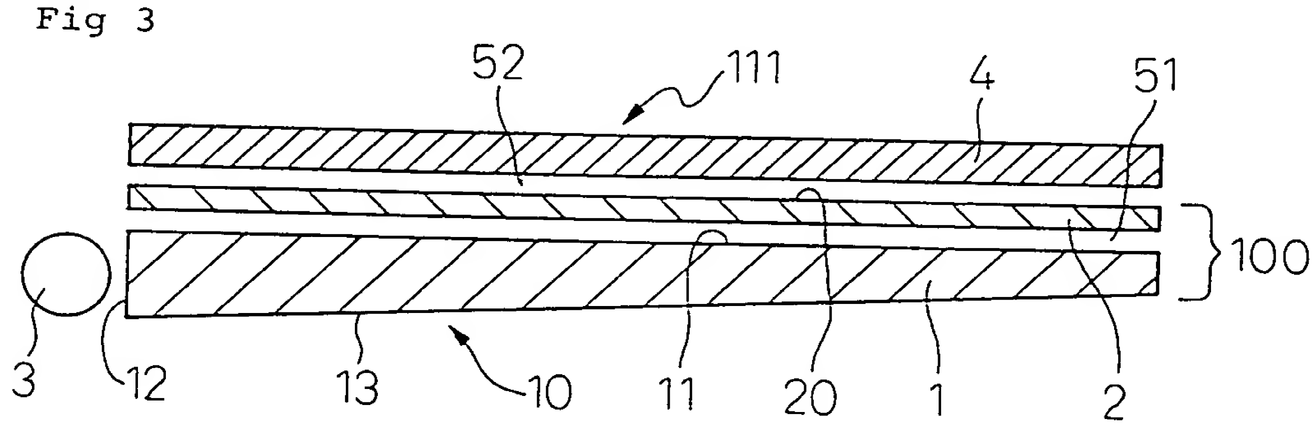


図 3
Fig 3



[NAME OF DOCUMENT] Abstract

[ABSTRACT]

[PROBLEM] To provide an optical laminated body which can reduce the number of parts, thereby to simplify an operation of incorporating parts in the production of an optical laminated body, and which can reduce the number of optical surfaces of the optical system as possible, thereby to prevent optical loss by interfacial reflection and to enhance the brightness of an area luminescence equipment.

[MEANS FOR SOLVING THE PROBLEM] An optical laminated body comprising:

a polarizing layer,

a first transparent film disposed closely to a front surface of the polarizing layer, and

a second transparent film disposed closely to a back surface of the polarizing layer,

characterized in that the polarizing layer comprises a reflective polarizing film, and both of the first transparent film and the second transparent film are diffusive films.

[SELECTED DRAWING] Fig. 2